There cannot then, I think, be any doubt whatever that jargonium is not only a new elementary substance, but is also one likely to throw much light on several important physical questions. By the time that the Society resumes its meetings, I trust that I shall be able to send a complete account of the whole of my investigations, including such facts connected with other substances as may serve to illustrate the very peculiar properties of this hitherto unrecognized element.

Postscript. Received June 18, 1869.

I here subjoin a brief account of the methods employed by Mr. David Forbes* and myself in separating zirconia and jargonia from one another. He separated apparently pure zirconia by means of strong hydrochloric acid, which dissolved the chloride of jargonium, but left chloride of zirconium undissolved; and obtained the approximately pure jargonia by adding to the solution excess of ammonia, and then considerable excess of tartaric acid, which left most of the tartrate of jargonia insoluble, but dissolved what may turn out to be a mixture of zirconia and jargonia with a third substance, not yet sufficiently studied—perhaps Svanberg's noria. My own analysis was only qualitative. I fused powdered jargon with several times its weight of borax, which gave a perfectly clear glass, completely soluble in dilute hydrochloric acid. After separating the silica in the usual manner, a slight excess of ammonia was added to the hydrochloric-acid solution of the earths, and then some oxalic and hydrochloric acids, which left undissolved apparently pure zirconia that had passed into an imperfectly soluble state. To the solution so much ammonia was added as to give a very copious precipitate, but yet to leave the solution with a very decided acid reaction. After removing the precipitate, which was chiefly oxalate of zirconia, almost or quite free from jargonia, excess of ammonia was added to the solution, and the washed precipitate digested in dilute hydrochloric acid, to remove peroxide of iron. The insoluble portion must have been approximately pure oxalate of jargonia, for it gave the characteristic spectra described below in remarkable perfection. Though this method succeeded far better than I anticipated, I do not yet understand the exact conditions requisite to ensure success, and have been prevented by absence from home from making further experiments.

IX. "Solar Radiation." By J. Park Harrison, M.A. Communicated by Prof. Stokes, Sec. R.S. Received June 12, 1869.

In a communication which the author had the honour of making to the

* Chemical News, June 11, 1869, vol. xix. p. 277.

Royal Society in 1867 *, it was shown, from observations of the black-bulb thermometer and Herschel's actinometer, that maximum effects of solar radiation occur at Greenwich, on the average, some weeks after the summer solstice, and about two hours after mid-day, when the atmosphere would appear to be charged with a considerable amount of vapour.

These results accord with the fact that the highest readings of the solar thermometer are met with in India in districts of great relative humidity †, the explanation of the phenomenon being, as the author ventured to suggest in the paper above alluded to, that an increase of insolation is produced by radiation from cloud and visible vapour.

During the two years which have elapsed since the spring of 1867, whenever the state of the sky and other circumstances permitted, special observations have been made for the purpose of ascertaining with greater certainty the nature of the relation between insolation and humidity.

Before proceeding to state results, it will afford additional proof that a connexion between the phenomena really exists, if a passage in the appendix to a work by the late Principal of St. Andrews, until very recently overlooked, is quoted in support of the fact. Mr. Forbes, writing some years ago, employs much the same words that were used in the paper above referred to:—"Cloudy weather, if the sun be not itself greatly obscured, apparently increases the effect of solar radiation" ‡.

The action, however, does not appear to be confined to days on which there is *visible* cloud; for even on cloudless days (so called) very high readings of solar radiation seem to be due to the presence of opalescent vapour, which can be easily detected if the hand or some other screen is held for a few minutes before the sun.

Thus, on May 2, 1868, at $1^h\ 30^m$, solar radiation appearing to be relatively intense, on raising a screen white glare was observed around the sun, and the tint of the sky, which had previously appeared a fair blue, was found, more especially in the south, to be very pale.

But the most interesting result of this series of observations is the discovery that an apparent increase of solar radiation occurs as the sun enters a white cloud of sufficient tenuity to allow free passage for its rays.

In October 1867, at 2^h, whilst attentively watching a solar thermometer, a sudden rise was observed to take place, upon which, the sun being immediately screened, it was found that it had entered the bright border of a cumulus.

On May 11, 1868, at $22^h\ 40^m$, as a very light cloud approached the sun, which was shining in blue sky, the mercury rose 4°, and in 30 seconds 3° more as it entered the white cloud.

On the same day, at 23^h, the reading of the solar thermometer was 101° F. when the sun was in the midst of cirri, but it fell in 3 minutes 9° when

* Proc. Roy. Soc., Feb. 1867.

† Proc. Roy. Soc., March 1865.

‡ Travels through the Alps of Savoy, App. III. p. 417.

well free again; then rose 6° as light cloud again crossed it. The air was perfectly still.

On May 15, 1868, the highest reading of the solar thermometer for the day occurred at $2^h\ 17^m$, just as the sun entered the skirts of a cloud.

On July 21, 1868, at 2^h, the maximum of the day (128° F.) was reached when the sun was shining in a patch of pale sky surrounded with white cumuli, some of which were within one or two diameters of its disk.

To mention one more example amongst numerous others which might be cited; on Aug. 3, 1868, at $0^h\ 40^m$, under an apparently clear sky, the solar thermometer registering 112°, and the temperature of shade 82°, in two minutes insolation increased to 125°, whilst the temperature of shade rose 0·3 only; on examining the sky in the neighbourhood of the sun, white cirri were detected crossing its disk.

Light cloud and opalescent vapour having been thus found, when in the direction of the sun, to intensify the effects of solar radiation, a series of experiments was commenced with circular screens of various sizes, to discover, if possible, *the distance* to which the effects of bright glare and light vapoury cloud extended round the sun.

The observations were made when the sun's altitude was between 30 and 50 degrees. All the screens were placed at a uniform distance of six inches from the bulb of a solar thermometer, $\frac{1}{4}$ in. in diameter, coated with China ink, and laid on a small piece of dark oak about two inches by ten inches on grass. The bulb of the thermometer was not covered with an exhausted globe. The mean results of the experiments were as follows* :—

1. A screen $\frac{1}{2}$ in. in diameter reduced the difference of the readings of the black-bulb thermometer and a thermometer in the shade, four yards distant, by one-third.

2. A screen $2\frac{1}{2}$ ins. in diameter reduced the difference by two-thirds.

On reversing the experiment, converse results were obtained, *e. g.*

The rays of the sun, after passing through a circular aperture $2\frac{1}{2}$ ins. in diameter in a 12-in. screen, were made to fall on the bulb of the solar thermometer, when the readings were found to equal in value those obtained when the instrument was entirely exposed†.

And no difference was noticed when the black-bulb thermometer was screened from the rest of the sky by a double cover of mill-board placed tent-wise over it.

* Similar results were obtained when the solar thermometer was laid upon short grass, in the afternoon, when the dew was off the ground.

With the instrument freely suspended 6 in. above the grass, the readings showed a proportionate fall.

† In the above experiments, it is evident that the whole of the results were not due to direct radiation or reflection. Account must be taken of the greater or less distance of the heated surface of the ground, and of the hot air in contact with it, from the bulb of the solar thermometer.

Results of an equally negative kind were obtained in the case of other experiments which were made with the object of detecting heat in the light reflected from sky and cloud not in the direction of the sun.

A black-bulb thermometer, after having been placed for some time in a dark room, was then exposed to the sky, near a large French window, facing S.E., the glass of which was clear, and had been carefully cleaned, without any rise being perceptible. The sun, at an altitude of about 40°, was shining brightly on white vapour and light cirro-cumuli*.

Thermometers were also placed in the open air on the north side of the house, on a still day, exposed to half the sky when covered with bright white clouds; but the mercury stood at the same height as in a dark passage on the same side of the building†.

The same apparent absence of any direct heating-power in the light reflected from the sky generally was shown in this, as in the previous series of experiments when the solar thermometer was screened, excepting in the direction of the sun.

As respects the momentary increase of insolation which occurs in connexion with bright vapour in the neighbourhood of the sun, further experiment is required for the purpose of ascertaining whether it is due to radiation or to reflection.

NOTE.—An opportunity occurred on the 7th of June of repeating the experiments with screens at altitudes of the sun exceeding 50°. The following results were obtained:—

h m			
At 0 0.	B. B. 110°. (Exposed to the sun and sky.)	Temp. of shade 73°.	Sky cloudless, but with a good deal of white vapour, more especially about the sun.
0 4.	B. B. 90. (Shaded from sun by a 2-in. screen.)	Temp. of shade 73.	,, ,, ,,
0 30.	B. B. 104. (Exposed to sun and sky.)	Temp. of shade 73.	Light air.
0 35.	B. B. 94. (Shaded from sun by a ½-in. screen.)	Temp. of shade 73.	Light air.
1 0.	B. B. 108. (Exposed to sun and sky.)	Temp. of shade 74.	Quite calm.
1 5.	B. B. 109. (Exposed to sun through a 2-in. circular aperture in a 12-in. screen.)	Temp. of shade 74.	Quite calm.
1 15.	B. B. 108. (Exposed to sun and sky.)	Temp. of shade 74.	Quite calm.
1 18.	B. B. 106. (Exposed to sun through a 2-in. circular aperture in a 12-in. screen.	Temp. of shade 74.	Quite calm.
1 20.	B. B. 106. (Exposed to sun but screened from sky.)	Temp. of shade 74.	Quite calm.

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* Experiments were also tried with a 7-inch lens, without result.

† The thermometer exposed to the sky would probably have stood *lower* than the one in the house if the sky had been perfectly clear.